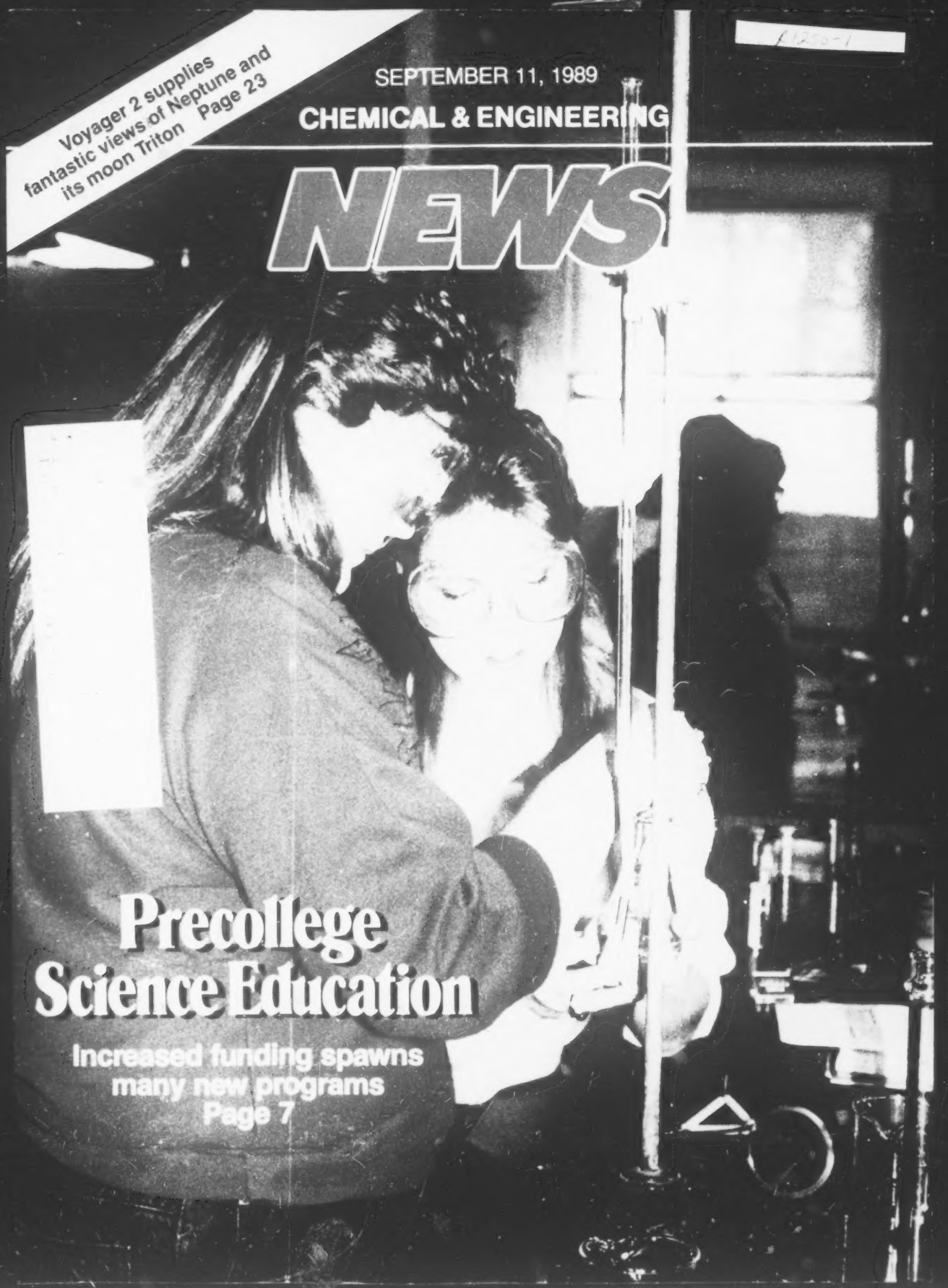
SEPTEMBER 11, 1989
CHEMICAL & ENGINEERING
NEWS

Voyager 2 supplies fantastic views of Neptune and its moon Triton Page 23



Precollege Science Education

Increased funding spawns many new programs Page 7

CHEMICAL & ENGINEERING
NEWS
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News of the Week

■ **Idaho has closed its borders to waste shipments from the Rocky Flats nuclear weapons plant, exacerbating the already critical problem of radioactive wastes disposal.** Page 4

■ **The Chemical Manufacturers Association says it is already taking steps with the Drug Enforcement Administration to ensure meeting President's goal of halting the flow of chemicals from the U.S. used to process drugs.** Page 5

■ **U.S. farmers should begin adopting less wasteful, costly, and polluting agricultural methods, a National Research Council study concludes.** Page 5

■ **White House has released its comprehensive plan on priorities for research on global environmental change.** Page 6

■ **Generic drug maker Lyphomed has accepted a takeover offer from Japan's Fujisawa Pharmaceutical Co., marking the first acquisition of a U.S. pharmaceutical company by a Japanese firm.** Page 6

Business

Hydrogen peroxide producers are adding capacity, mostly to meet demand in pulp and paper but also for new and growing applications. **Page 15**

Government

Most of the cost of cleaning up the environment over the next decade will have to be shouldered by state and local governments, a recent report forecasts. **Page 19**

The likelihood of acid rain legislation this Congress has spurred EPA and state air control groups to weigh programs for meeting the new requirements. **Page 20**

Science/Technology

Voyager 2's near perfect encounter with Neptune provides scientists with abundance of data about fundamental aspects of mysterious planet. **Page 23**

Education

Teaching polymer chemistry at small colleges is focus of summer course held at Rensselaer for selected chemistry faculty. **Page 30**

Baltimore City Elementary Schools Science Expo culminated citywide program of science fairs involving 5000 students, 100 schools. **Page 31**

ACS News

ACS announces 1990 winners of its national awards, most of whom will be honored next year at Boston ACS meeting. **Page 32**

Cover: Students take part in precollege program at Tennessee Technological University

News Focus

Increasing funds from National Science Foundation coupled with innovative activities by industry, universities, and government agencies have brought new vitality to precollege science and math education programs. Page 7

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LETTERS

Supercomputer estimations

SIR: In your interesting article, "Improved Access to Supercomputers Boosts Chemical Applications" (C&EN, July 17, page 29), Du Pont researchers calculated the difference in the enthalpy of formation in the gas phase of *m*-diaminobenzene and *p*-diaminobenzene using a supercomputer. It is gratifying to see that the supercomputer value of 12 kilojoule mol^{-1} verifies the experimental value of 11 ± 4 kJ mol^{-1} for the crystal phase. The experimental data and estimates of their accuracy are available in "Thermochemical Data of Organic Compounds" by J. B. Pedley, R. D. Naylor, and S. D. Kirby. The article does not state the estimated accuracy of the supercomputer value, but there are few estimations methods that give accuracies to better than 4 kJ mol^{-1}.

Heats of formation of chlorofluorocarbons were also estimated via supercomputer. It would be interesting to see how these values compare with the extensive set of enthalpies of formation of these compounds recently published in the "TRC Thermodynamic Tables—Non Hydrocarbons."

Kenneth N. Marsh, *Director*
R. C. Wilhoit
Associate Director
Thermodynamics Research Center
Texas A&M University

Educating the public

SIR: Michael Heylin's editorial "Chemists' Pride" (C&EN, May 1, page 5) was right on target. As a second-generation chemist I have experienced the change of the general public's attitude toward the profession. Is there a 30-year-old profession that hasn't changed?

I have become complacent about attending public relations meetings sponsored by ACS, but I have a suggestion for our profession. The public is very uneducated about chemistry. Sodium chloride, H_2O, sodium bisulfate are foreign terms. If it's foreign, most people get scared. It's human nature, not rampant ignorance.

My suggestion is based through our association. Chemists need to educate the public. The public receives most of its education from television. Chemists need to be polished in presenting their work and themselves. Take a Ph.D. who has won hundreds of awards, written thousands of articles, and is well esteemed in our profession versus a high school student who has just won the county science fair award. People relate more to the student and his or her work than to the professor.

I am requesting chemists to input chemical names whenever possible into the product they develop, especially if the product is "clean." A clean product is one where no possible environmental liability can take place. Soaps need to stress the chemical names like surfactants. Instead of printing fragrance put "chemical fragrance." I don't know what a nonchemical fragrance is. We're reestablishing a good connotation—"fragrance" with the term chemical.

All legitimate pharmaceuticals need to have the label, "This product was invented by a chemist. On behalf of ACS we hope you enjoy it."

Saturday mornings, have an ACS-sponsored cartoon. Mr. Magoo giving a very fundamental lesson revolving around chemistry.

The point is there are hundreds of ways to emphasize the positive aspects of our profession. Let the general public know that chemists can solve our chemical problems.

Don T. Pearson
President
Smiseth Corp.

Upper atmosphere

SIR: I welcome the opportunity to join Roland Beck (C&EN, June 26, page 62) and others who look skeptically on the chlorofluorocarbon hypothesis as the explanation for an ozone hole in the upper atmosphere over Antarctica.

Seldom has such unquestioning acceptance of a theory come from such diverse scientific quarters without a more critical investigation of alternative hypotheses. It seems ironic that we should be spending millions of dollars (in finding substitutes for CFCs) to apply an untested remedy to one serious environmental problem, while balking at the cost of using technology known to remedy another, namely smog. The ozone hole is an important, perhaps a life-threatening, problem; but are we prudently allocating and prioritizing our resources?

The distribution of ozone might be related to the distribution of charged particles, including solar protons, and radionuclides in the upper atmosphere. Before the atom bomb was developed, it was proposed that fission products distributed locally in the upper atmosphere could be used as a weapon, to remove the protective ozone layer, to destroy life beneath. Although we receive some news about radioactive fallout from bomb tests, Three Mile Island, Chernobyl, satellites, and so on, and about radon daughters rising from the earth, we hear little about the distribu-

States Bear Growing Share of Environmental Cleanup Cost

Report finds that most states are hard-pressed to meet the expense of existing programs, predicts bulk of burden will fall on states in the future

Between now and the year 2000 the cost of environmental protection may grow almost $21 billion in real terms, and state and local governments are going to have to bear the bulk of that burden, says the National Governors' Association in a recent report. They are already bearing a growing share of the burden, and most states are struggling to meet the cost of existing environmental initiatives.

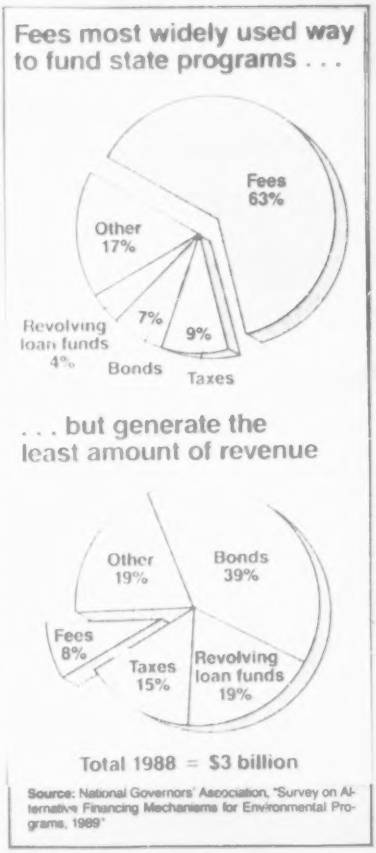
The report points out that state environmental programs were the recipients of 28% of the Environmental Protection Agency's $1.8 billion operating budget in 1979. Within 10 years the states' share has dropped to 18% and EPA's budget has fallen to $1.7 billion. Although many states have increased their appropriations from general revenues for environmental programs, there often isn't enough money available to fund them fully.

Given the gap between the cost of environmental protection and the resources available to pay for it, the National Governors' Association surveyed the 50 states to find out how they were coping. Forty-six states responded to the survey, the results of which are detailed in the report, "Funding Environmental Programs: An Examination of Alternatives."

According to the report, the most widely used alternative to federal grants or general revenues is a fee, followed by taxes, bonds, and revolving loan funds. A number of miscellaneous alternative financing mechanisms also were identified in the survey, including fines and penalties, recoveries from responsible parties, private contributions, lottery proceeds, investment income, and loan repayments. The total amount raised through all these mechanisms in 1988 was about $3.2 billion. About 92% of the proceeds were dedicated to a specific environmental program.

Fees don't raise much money, only $240 million, or 7.5%, of the reported total, but they certainly are popular. The survey found 272 fee programs in use in 43 states. Thirty-three states reported using 89 hazardous and solid waste fee programs, including application and permit, disposal, and generation fees, that generate more than $96 million annually. Twenty-three states collect roughly $56 million each year through a total of 51 programs that impose permit or emissions fees on sources of air pollutants; and 30 states use fee programs to finance water quality control activities. Those states derive about $46 million annually from 86 programs.

Wisconsin leads all states in the number and variety of fee programs. It has 32 different programs that raise about $10 million annually. The state has several landfill disposal fees, new car and waste tire fees, and an acid deposition fee in addition to air permit fees. In the water area alone, it imposes a laboratory certification fee; sanitary permit and license fees; a storage tank installation fee; a septic system fee; a well drillers' permit fee; a water regulation permit fee; a pump installers' permit fee; dam safety fees; a petroleum cleanup surcharge fee; pesticide and fertilizer sales fees; aquatic nuisance fees, as well as an acid rain-aquatic nuisance fee; a compensation fee for wells; and a soil and plant additives fee.



Source: National Governors' Association, "Survey on Alternative Financing Mechanisms for Environmental Programs, 1989"

The survey found 37 tax programs in use in 16 states that raise about $490 million annually. Of that amount $152 million is devoted to hazardous and solid waste programs, $104 million to air programs, and $88 million to water programs. The remaining revenues couldn't be classified as to end use, according to the report. California raises the most, $104 million annually, through taxes. Vehicle registration and driv-

er's license taxes raise $46 million, and local district charges for air operating permits raise another $58 million. All of the money goes to air programs.

Washington is alone so far in financing its water quality programs through the imposition of a "sin tax" on tobacco and cigarettes. But the report notes that to cover revenue needs, other states have indicated that they are considering new laws that will increase sin taxes. These taxes are popular for three reasons, the report explains. "First, lawmakers have found that products such as liquor and cigarettes are relatively inelastic goods; thus they can be taxed without a significant fall in consumption. Second, because the tax base is large, the revenues generated are usually substantial. Finally, taxing these products is generally more palatable to taxpayers than raising other taxes."

Bonds are the most lucrative of the alternative financing mechanisms examined in the report. Twelve states raised almost $1.3 billion through the issuance of general obligation ($850 million) and revenue ($403 million) bonds to fund environmental projects.

But bonds have their drawbacks. General obligation bonds usually require legislative or voter approval, which isn't always a certainty. And as the report points out, the 1986 tax reform act imposed a number of restrictions on revenue bonds, making them much more difficult to issue. Many of the act's restrictions, the report says, are directed at projects that involve both public and private participants, such as solid waste treatment plants built through public revenue bonds. These projects often have proved to be more cost-effective than facilities financed and operated solely by the government, the report says.

Revolving loan funds, which require large infusions of up-front money, totaling $597 million are in use in 13 states. The majority of these funds, according to the report, were established mainly to cover the cost of completing municipal wastewater treatment systems required by the Clean Water Act of 1987.

Janice Long

States preparing for acid rain legislation

A new clean air law is looking more and more likely from the 101st Congress. Several legislators have submitted different bills for updating the nearly 20-year-old law, and even the Administration has come forth with a proposal. One of the main functions of any new clean air law will be reduction of acid rain. And in a rare burst of governmental foresight, the Environmental Protection Agency and state air control organizations are already working on having programs in place able to meet the new requirements.

Beginning in 1984, EPA provided several states with a total of nearly $3 million to develop future acid rain control strategies. The 47 projects funded provided the start for what became known as the State Acid Rain (STAR) Program. This was a unique program because it responded only to the threat of legislation, not to a law already enacted. EPA has recently released reports describing the results of the program and providing guidance for all states on how to cope with the impending law.

Controlling acid rain by significantly reducing industrial emissions of sulfur dioxide and nitrogen oxides that are the precursors to acid rain presents states with a problem of scope and distribution they have not faced before. Existing state regulatory authorities are designed to settle in-state pollution problems, not interstate problems. And the problem is further complicated by the multistate operations of many pollution emitters.

Not knowing just how Congress is going to require them to control acid rain, the states have four control strategies in mind. A source-based program would restrict the amount of pollutants from each source, say plant or automobile. An emission-based program would focus on total emissions over a defined area. A third type is pollutant loading based, under which each pollutant would have a set concentration limit in the environment. Fourth, an environmental effects-based program would protect the most sensitive people, plants, or animals from the effects of pollution.

The type of program, then, that Congress chooses will influence how the states respond, and the STAR program has examined the impacts of each. Issues of equity and efficacy have been studied, as have the problems of how an acid rain program will affect existing air programs, the involvement of multiple agencies in setting up a control program, and interstate coordination.

One aspect of acid rain control the states are considering seriously is energy conservation. A number of studies have been performed to figure out how much energy, and consequently pollution, can be cut by conservation. STAR participants point out that conservation has a short payback period and eliminates, or at least defers, industry needs for capital construction of facilities. However, there are some problems. It seems that the first generating units that would be turned off would be the more expensive new and cleaner units. Also, utilities must make some money by selling electricity and this would be curtailed with strict conservation.

In the end, it probably will be some combination of conventional control technologies that will be used. These include scrubbers, fuel switching, and clean coal technologies. Fuel switching entails replacing high-sulfur coal with oil, natural gas, or low-sulfur coal. New technologies for cleaner burning fuels, such as fluidized-bed combustion, advanced fuel gas desulfurization, and integrated gasification combined cycle turbines, are promising, but may run into problems from existing air rules or from reluctance of companies to invest in unproven methods.

Even with the control strategies somewhat in focus, states will not be able to instantly implement technologies to drastically cut sulfur dioxide and nitrogen oxides emissions. States participating in the STAR program indicate that it could take at least 24 months, and preferably 30 months, to develop full control plans once Congress has passed legislation.

David Hanson